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ABSTRACT

This activity and record book is designed for unit 2 (ages 12-14) of the Nebraska 4-H Energy Project. Aims, energy attitudes to be developed, and instructions are provided for each activity. Activities include: (1) a word search of energy-related words (with definitions provided); (2) determining fuel waste; (3) reading electric/gas meters and examining electric/gas consumption; (4) analyzing electric appliances; (5) making home comfortable at lower temperatures (insulation); (6) conducting home energy audits; (7) constructing a model solar collector; (8) making a solar water heater; (9) conserving energy in the kitchen; and (10) monitoring gasoline usage. (Suggestions for giving demonstrations at 4-H Club meetings or in the community are also provided. (JN)

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energy

Unit 2

Member Guide

EC 13-16-80

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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

EXTENSION WORK IN "AGRICULTURE, HOME ECONOMICS AND SUBJECTS RELATING THERETO."
THE COOPERATIVE EXTENSION SERVICE, INSTITUTE OF AGRICULTURE AND NATURAL RESOURCES,
UNIVERSITY OF NEBRASKA-LINCOLN, COOPERATING WITH THE COUNTIES AND THE U.S. DEPARTMENT OF AGRICULTURE
LEO E. LUCAS, DIRECTOR

Dear 4-H Member,

Due to depletable world energy sources, energy education and the intensive search for alternatives will remain important in your lifetime. Your participation in the 4-H Big E Energy Project through the Cooperative Extension Service will enable you to —

1. find thrifty ways to reduce utility bills
2. audit home energy use for reduced fossil fuel consumption
3. explore alternative energy resources, including energy conservation
4. make energy-wise food choices
5. monitor transportation activities
6. share energy ideas in the community

You should be able to complete Unit 2, write in it as a workbook, and design an alternative energy model. Match the six goals above with the activities on the next page.

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Recycled paper has been used for this book.

EVERY PAGE HAS SOME ENERGY IDEAS FOR YOU TO TRY. WRITE YOURSELF SOME DEADLINES AND WRITE IDEAS IN THE RIGHTHAND COLUMN BELOW. FINISHING EVERY PAGE WILL BE SUNSATIONAL!

PAGE	ACTIVITY	PURPOSE	DATE DONE
2	LETTERS TO MEMBERS	to understand the energy project	
4	A-MAZING FACTS ABOUT ENERGY	to learn new energy words	
6	1. WHAT'S A PENNY SAVED?	to watch pennies pile up	
7	WATCH FOR WASTEFULNESS	to find ways to use fossil fuels wisely	
10	MEET THE METERS	to measure quantities of energy used by family	
11	APPLIANCE ANALYZER	to reduce electrical usage	
17	2. INSULATION SENSATION	to understand insulation	
22	HOME ENERGY AUDIT	to monitor home energy problems	
24	3. COLLECTORS BOX	to build a solar heat collector as a special project	
29	4. KITCHEN CONSERVATION	to eat low energy meals	
31	5. TRANSPORTATION—ALL SYSTEMS GO!	to change transportation habits and reduce oil imports	
34	6. DEMONSTRATIONS GALORE!	to share energy ideas	
36	ENERGY ALTERNATIVES	to seek future energy producers and recyclers	
37	ENERGY PLAY	to enable others to enjoy the energy concepts you know	
38	RESOURCES		

A-MAZING FACTS ABOUT ENERGY

UNDERLINE THE WORDS YOU ALREADY KNOW!
THEN FIND THEM IN THE PUZZLE

BARREL-international unit for crude oil or petroleum-one barrel contains 42 gallons (160 liters)

BTU-British Thermal Unit-small amount of heat energy needed to raise temperature of 1 pound of water 1 degree Farenheit (metric unit is the Kilo-Calorie)

CELSIUS-temperature scale with 100 equal degrees—0° C = ice point 100° C = steam point

COAL-dark, solid fossil fuel

DOE-Department of Energy is U.S.A.'s major energy information helper

DOER-4-H'er who gets energy project done

DRAFTY-what a holey house with air leaks becomes

ELECTRICITY-energy form found in nature measured in watt and kilo-watt hours

EATER-human who consumes food for energy

ENERGY-the capacity to make things work by moving, heating, or lighting things

FOSSIL-source of energy from past plants and animals

FUEL-something that is burned for heat, light or motion

FUSION-a future type of nuclear power that will use hydrogen from sea water as a fuel source

GAS-invisible fossil fuel: natural gas is our lightest weighing petroleum product

HEAT-a rise in temperatures of gases, liquids or solids by adding energy

HOME-a major place for you to save energy besides transportation

LIFE-STYLE-daily living habits that influence energy and fuel consumption

LIGHTS-electrical objects in the home that enable us to see

NUCLEAR-power using the atom

OIL-a greasy, liquid fossil fuel

PLASTIC-synthetic material found in many consumer products made with and from fossil fuels

PLANT-world's best storer of sun's energy

POWER-a means of transforming energy sources into work

SHARE-what you do with the energy ideas learned in the Big e project

SOLAR-energy from the sun that travels through space, making its eight minute dash to Earth

FIND THE HIDDEN ENERGY WORDS AND ABBREVIATIONS ACROSS, DOWN, AND DIAGONALLY. HOW ARE THEY RELATED TO ENERGY? CIRCLE THE WORDS WITH THICK LINES TO CREATE TWO IMPORTANT NAMES.

H	M	T	R	e	R	S	L	R	E	N	P	I	R	N	P
O	B	T	W	N	I	E	E	O	O	U	F	P	O	L	L
M	L	S	A	E	O	N	L	P	E	C	U	M	R	A	A
E	A	T	E	R	I	D	O	Z	R	L	I	G	H	T	S
C	T	A	I	G	K	O	S	H	R	E	P	I	E	P	T
S	A	C	C	Y	L	E	F	R	D	A	A	C	S	O	I
T	U	K	C	S	N	X	R	L	I	R	T	G	C	L	C
A	R	B	R	I	J	K	L	M	N	R	P	B	U	L	G
A	R	L	M	P	S	D	O	E	D	E	O	A	L	A	H
B	E	I	Z	A	L	B	T	U	S	R	B	I	L	H	T
D	S	R	G	A	M	M	C	P	Q	H	A	C	S	E	Z
E	I	Q	O	S	T	U	V	W	X	Y	A	F	K	E	R
E	R	C	L	I	F	E	S	T	Y	L	E	R	T	U	D
S	T	E	L	E	C	T	R	I	C	I	T	Y	E	Y	I
R	A	L	H	F	R	P	N	S	K	A	T	U	H	C	A
I	I	S	E	U	O	L	C	E	K	T	A	C	K	W	L
O	N	I	A	S	G	N	Z	D	U	R	I	H	R	I	U
F	R	U	T	I	S	N	I	A	L	P	R	A	S	D	E
O	U	S	V	O	B	A	R	R	E	L	L	S	R	A	N
E	I	E	T	N	P	L	A	N	T	O	O	S	H	Z	P
R	B	N	L	P	O	W	E	R	S	F	Q	L	R	A	C

ANSWERS TO THE PUZZLE ARE IN YOUR LEADER'S GUIDE.

WHAT'S A PENNY SAVED?

AIM:

- to understand how small amounts of wasted fuel per American can add up to enormous quantities nationally

When Ben Franklin said "A penny saved is a penny earned," the cent was worth a lot more in the 18th century than today. About the time you were born, money and energy resources seemed to be plentiful. People grew accustomed to consuming nonstop. In this fossil fuel-using century our daily living habits affect every drop of oil, lump of coal, and jet of gas.

ACTIVITY:

Club members sit on the floor in a circle. Each member gets a penny and places it in center of circle.

If each person in your town saved a penny, how much money would that total?

$_____ TOTAL PENNIES FROM TOWN POPULATION

How many pennies would there be for every person in the nation?

$_____ TOTAL U.S. POPULATION*x1 cent (*about 225 million Americans)

There are about 80 million households in America, if each family tried to save a dollar from monthly home heating/cooling bills, how much money could be saved? $_____ TOTAL DOLLARS SAVED MONTHLY BY HOUSEHOLDS

With over 100 million automobiles in America, if each driver tried to cut back gasoline by 2 gallons per week, how many gallons would be save each week?

$_____ GAL. PER WEEK _____ GAL PER YEAR How many liters would that be? (Gal. x 3.8 = liters) _____ LITERS PER WEEK _____ PER YR. Write here how you feel about the penny now:

(NAUT: Fuel unburned is a penny earned – only if you don't use the fuel in the first place: Our three main fossil fuels – coals, natural gas, oil – are burned to produce heat energy that drives machines. Because of friction, impure materials and machine inefficiencies not all of the fuel gets used up. Remember, energy can't be destroyed but it can be lost. Energy's form changes, often into heat that goes to waste. Extra energy is used to keep our machines from overheating.)

WATCH FOR WASTEFULNESS

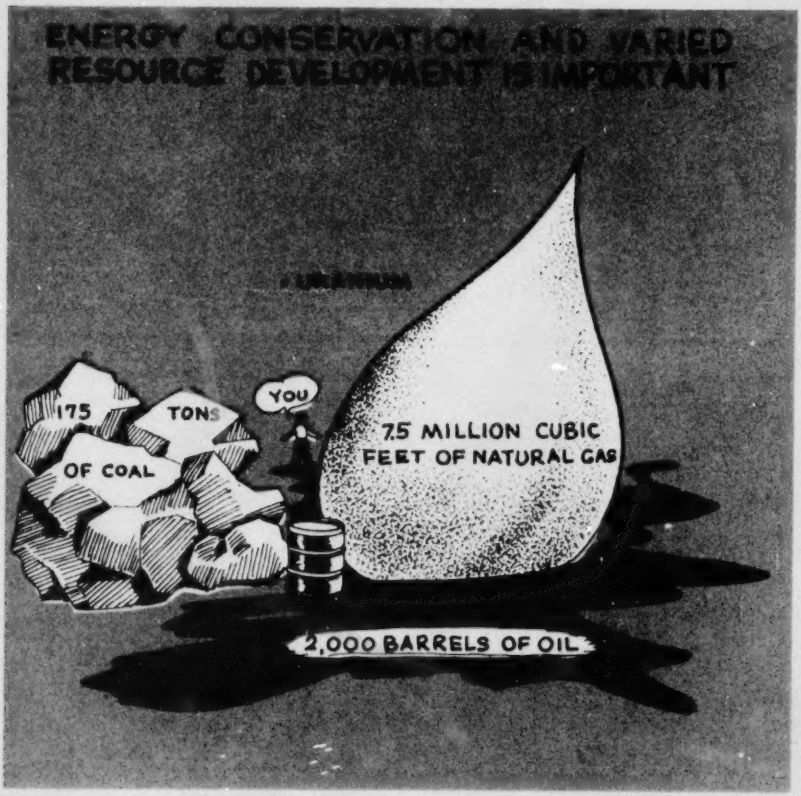
AIM:

- to find ways that fuels are used and wasted

ATTITUDE:

Fuels do not burn with total efficiency. We still have a long way to go to design machines without wasting most of the energy.

Adding to the wasted fuels is human behavior. Americans have been consuming fuels at a high rate. These fuels go into home heating/cooling, electricity, plastics, fertilizers, detergents, medicines, and other chemicals and are used during the manufacture of products. Therefore, one person in a lifetime may consume — 175 tons (160 metric tons) of coal, 7.5 million cubic feet of natural gas, a dot of uranium (1/2 pound, 227 grams) for splitting atoms, 2,000 barrels of oil (320,000 l).



ACTIVITY

Form four groups. Have each group represent a fossil fuel: coal, oil, gas, uranium for nuclear power. Make a list how people use fuels at home. Compare with methods used by grandparents. For fun, see if the group can predict some new ideas and fuels for 2001 A.D.

HOME ACTIVITY	EQUIPMENT USED IN YOUR HOME	FUEL USED	ITEMS USED BY GREAT GRAND-PARENTS
cook food			wood stove
wash clothes			wash tub
dry clothes			sun and clothesline
heat house			fireplace, wood stove
cool house			wind, open windows
light house			kerosene or gas lights
keep warm sleeping			layers of quilts
clean carpeting			carpet beater
drill holes			hand drill
communicate			crank telephone, yodel
get instant sound			sing, music instruments
count			fingers, pencil, paper
store information			files, albums
preserve ice			ice house
keep time			pocket watch
cut wood			handsaw, axe
dispose garbage			shovel to bury it, burn
travel			horse and wagon, bike
stir food			wood spoon and bowl
cook seeds			pan for popcorn or coffee

Discussion: What happens to the heat in the above processes performed by machines?

Do you have any suggestions for ways to recycle the wasted heat from any of the above?

AFTERWARDS

Stay in the same groups. Plan and design together posters with ideas for conserving a fuel. Ask for permission at school if you may post them somewhere in the building.

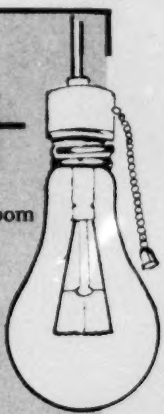
Every family member has different daily habits. Does that person have any

energy wasteful habits (for instance, is the bedroom light left on when that person is showering? Does the person carpool, but waste plastics or rinse dishes in hot water?)

Observe your family's (and your own!) energy usage for a week. What daily habits can be changed to improve your budget and energy behavior? Make a list of habits to improve:

ENERGY USE HABITS

wasteful activity	ways to improve habits
example: lights left on in unused room	shut off lights when leaving room



Post reminders around the house, in the form of slogans, rhymes, or use this list.

MEET THE METERS

AIM:

- to find out how much electric energy (and gas if used) your family consumes in a month
- to compare costs during an energy conserving month

ATTITUDES:

Families that use electrical energy wisely are saving fossil fuels. Only a third of the heat from electric power generation is turned into useful energy. The rest is lost, unless the power plant directs the heat into useful work.

ACTIVITY:

A kiloWatt-hour (kWh) = 1000 watts of electricity used for 1 hour. Ten 100 - watt light bulbs burned 1 hour use 1 kWh.

For an entire month, the same time each day, record the number of kWh on the electric meter. With an adult, compare the use of major appliances as they vary each day for a month. Do the meter kWh's increase with use of these appliances? Yes_____ No_____

MONTH _____ KILOWATT READINGS FOR ONE MONTH (same time of day) TIME OF DAY: _____

1)	2)	3)	4)	5)	6)	7)
8)	9)	10)	11)	12)	13)	14)
15)	16)	17)	18)	19)	20)	21)
22)	23)	24)	25)	26)	27)	28)
29)	30)	31)				

Subtract the first day's reading from the last day: _____ kWh for month. Which days were peak days of usage? (Circle these.) (You will need to subtract each day from its succeeding one to find differences.) _____ number of peak days. Compare these with the notes you take about appliance use.

Which major appliances in your home are the greatest electrical consumers?

_____

List ways that you and your family can use these appliances more efficiently:

1.

2.

3.

4.

5.

Plan with your family to have an energy-efficient month. Monitor your meter periodically. Was there any difference between the kWh usage and bills from last month and the energy conservation month? Yes_____ No_____ Why?_____

Which energy saving habits does your family plan to continue?

1.

2.

3.

READING THE ELECTRIC METER

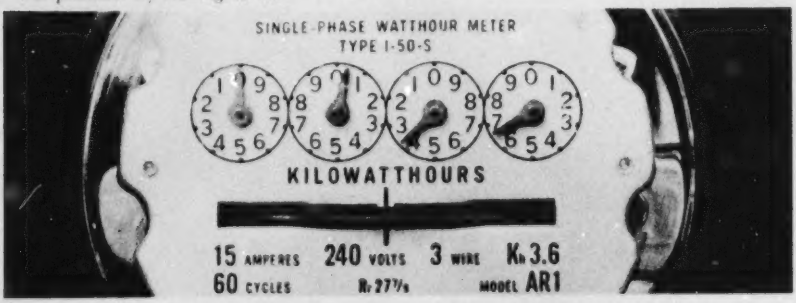
It may be of two types. If this kind, read and write down what you see for a month:

8 8 6 2 6 CYCLOMETER

A dial meter has four or five circles - read left to right:
When a pointer is between two numbers write down the lowest number. Exception: between 9 and 0 (0 = 10) use 9. Between 1 and 0 choose 0.

Otherwise: If a dial is "in between", choose the lower number seen!

For practice, try reading these:



KiloWatt-Hours: multiply by 10 = _____ kWh

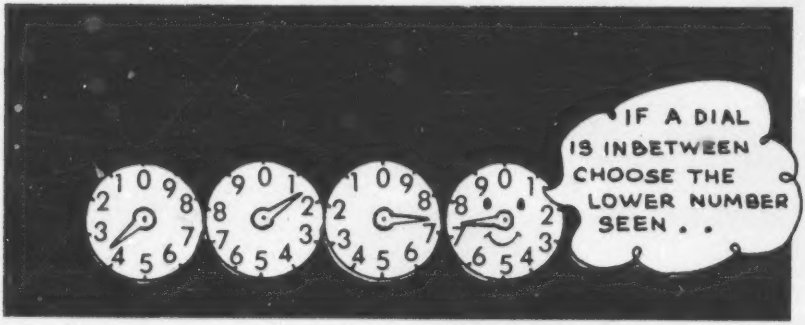
Note: Many rental units are not equipped with an individual meter. Ask the landlord for information.

READING THE GAS METER:

Natural gas is measured by the cubic foot, a volume of gas with the ability to produce heat measurable in therms. A therm = 100 cu. ft. of gas or about 100,000 BTUs (BTUs, or British Thermal Units are small measures of heat content of fuel), or about 25,000 kilo-Calories. This varies depending upon the quality of fuel. Now for the meter: It is read in much the same way as the electric dial meter with the alternate dials moving in opposite directions. When you get the reading multiply by 100.

_____ x 100 = _____ cu. ft.

Example: Subtract Day 11 3188000
Day 1 3177000
Gas used in 10 days = 11000 cu. ft.



These ENERGY ANAGRAMS will remind you to help lower utility bills. Rearrange to make a sentence.

1. used being not electricity any off turn

2. machine wash full in clothes loads

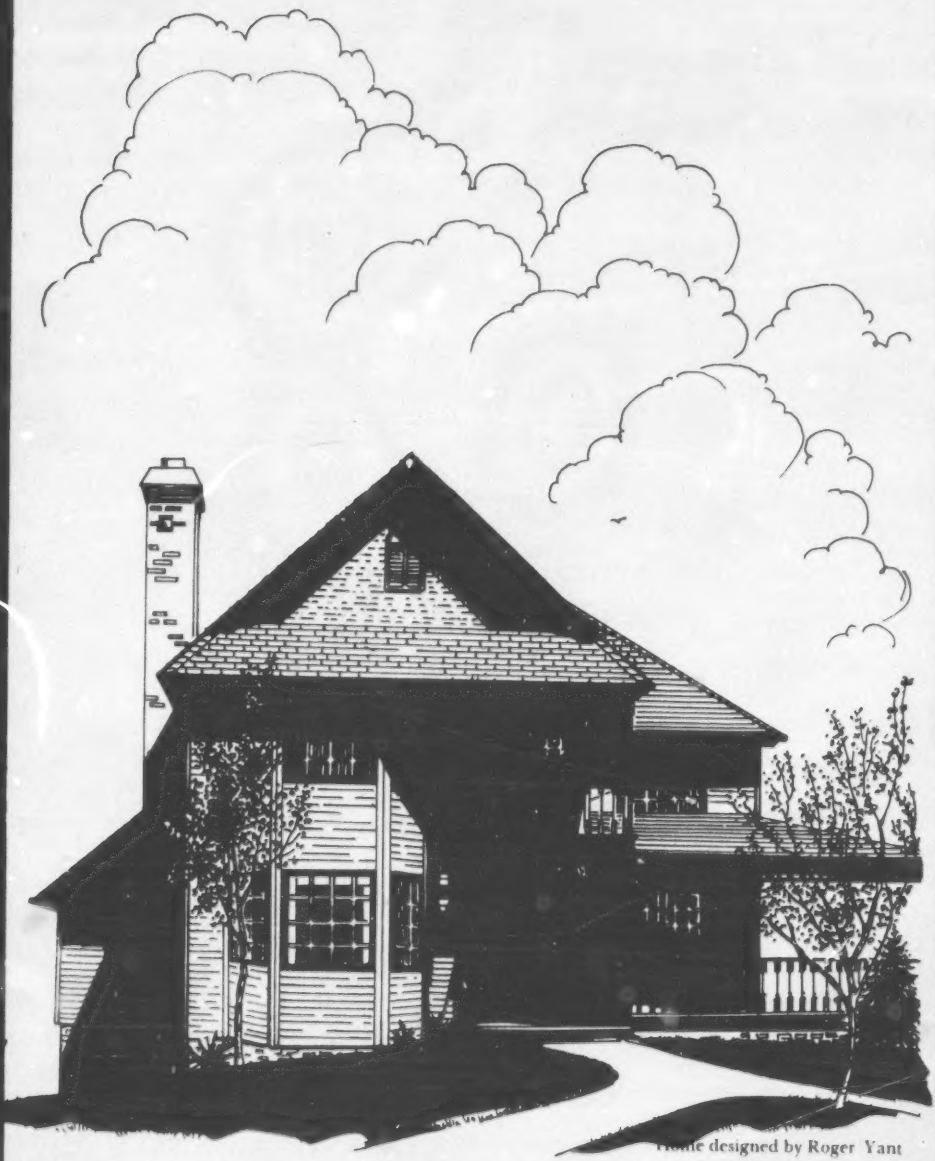
3. dishes rinse in air after dry dishwasher

4. water than less use showers baths short

5. appliances condition keep operating top in

6. electrical are energy we savers of

Check your answers with those in your leader's guide.



Home designed by Roger Yant

Utility Bills

Add up your utility bills for the last two years. Will there be any changes with energy conservation?

UTILITY	ELECTRIC	GAS (if used)	HEATING OIL (if used)
TOTAL COST LAST YEAR	$	$	$
TOTAL COST TWO YEARS AGO	$	$	$
SUBTRACT DIFFERENCE	$	$	$
HAS COST GONE UP? Yes_____ No_____ Why?			
TOTAL THIS YEAR'S BILLS AFTER THREE MONTHS OF ENERGY CONSERVATION.			
IS THERE A SAVINGS? Yes_____ No_____			

DECIDE WHICH BILLS AND LIFESTYLES YOUR FAMIY PREFERS. PROJECT ONE OF THE ABOVE TOTAL ANNUAL COSTS TO A 10 YEAR COST TOTAL. (x 10). WRITE THE ANSWER HERE. $_____ FOR 10 YEARS.

APPLIANCE ANALYZER

AIM:

- to analyze an electrical appliance
- to develop an electric use awareness

ATTITUDE:

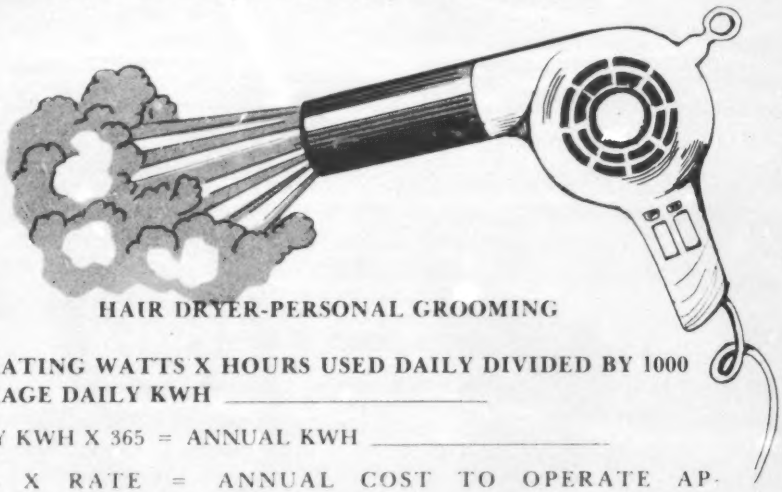
Benjamin Franklin's kite and key demonstrated the presence of electrical energy in the atmosphere. Homes did not have electrical power until George Westinghouse and Thomas Alva Edison showed electrical current could be controlled. Now electricity is very important and versatile in our daily lives.

NAUT: One 100-watt lightbulb burns 100 watts of electricity in an hour. That equals 1 fluid ounce (30 milliliters) of oil or 1 and 1/3 ounces (37 grams) of coal from the energy company. Cost of operation equals 1,000 watts (W) = 1 kilowatt (KW). W = V (volt) x A (amperes). 1 KW x 1 hr. = 1 KWH, and KWH x rate. Check your electric bill for the rate (usually about 5 cents per KWH).

ACTIVITY:

How much fuel do you need from the energy company to get ready in the morning? Write down the electrical appliances that you need for personal grooming:

Then calculate their cost of operation for a year. For instance, analyze a hand-held hair dryer. Check its wattage on the name plate. Tape file cards to appliance handles for the family to record daily use in minutes.



HAIR DRYER-PERSONAL GROOMING

OPERATING WATTS X HOURS USED DAILY DIVIDED BY 1000 AVERAGE DAILY KWH _____

DAILY KWH X 365 = ANNUAL KWH _____

KWH X RATE = ANNUAL COST TO OPERATE APPLIANCE $_____

Example: 750 watts x 1/4 hour divided by 1000 = .19 Daily KWH

19 x 365 = 69 Annual KWh 69 x .05 = $3.45

If 70,000 4-H'ers in your state used hair dryers, how much would the annual cost be? $_____

What would it cost in their lifetime? (figure annual cost x 40 years) $_____

If these same people doubled their daily use of electricity and time, what would happen to your cost calculations for personal grooming?

SHAVING SAVING IDEA:

You actually use less fossil fuels with an electric shaver than with a razor because there are no disposable parts, hot water, or shaving cream containers for a plug-in shaver.

ELECTRIFYING THOUGHTS:

- Which appliances in your home aren't really necessary?

- Are there more energy efficient models (with fewer energy-using parts) than certain appliances you have? This will require some appliance window-shopping to compare new models with yours.

MY FAMILY'S NECESSARY APPLIANCES	WHAT ENERGY SAVING FEATURES DO THE LATEST STORE MODELS HAVE?

INSULATION SENSATION

AIM:

- to make the home and body comfortable at 68°F(20°C) and less in winter.

ATTITUDES:

Insulation is any material that resists the movement of heat to and from active and less active space. In order for insulation to be effective it requires air pockets (or dead air spaces) and vapor or moisture barriers.

Some items that have air pockets are thermos bottles, thermal paned windows (two or three layers of glass with air space between), wall insulation such as loose fill cellulose or fiber glass batting, thermal blankets and fabrics of open construction. Why is a sweater pocket a warm place?

How does your dictionary define "thermal"?

Why do some animals resist cold weather better than others? Polar bears, ducks, otters, seals have fatty layers or oil glands that serve as vapor barriers. Have you ever shivered in the cold when your skin and clothes were wet?

Two important winter survival items for people are home insulation and clothing. People whose homes are weatherproofed, who lower their thermostats and wear layered clothing in winter find personal comfort at reduced energy costs. Even in summer wall insulation, caulking and weatherstripping and storm windows and doors kept on all year will resist heat flow into a home.

ACTIVITY:

Our average body temperature is 98.6°F (37°C) and skin temperature is 91.5°F (33°C). Each person, however, may choose a room temperature that differs from others. Generally, wearing layered clothing in winter enables us to lower our thermostats by 3°F (1.5°C).

Interview family members and find out which room each likes best in winter and summer. Ask if temperature, comfort and room color or clothes have anything to do with their choices.

REASONS:

A. Temperature

B. Feels Comfortable

C. Room Color

D. Other

WINTER				
FAMILY MEMBER	FAVORITE ROOM	REASON	TEMPERATURE	
			°F	°C

SUMMER

FAMILY MEMBER	FAVORITE ROOM	REASON	TEMPERATURE	
			°F	°C

- Find a room thermometer and masking tape. Go to each room to check on the temperature when the heating or cooling equipment is on. Tape the thermometer firmly against the inside surface of an exterior wall. Wait for 5 minutes and record the temperatures on the chart under the appropriate "winter or summer room" heading.

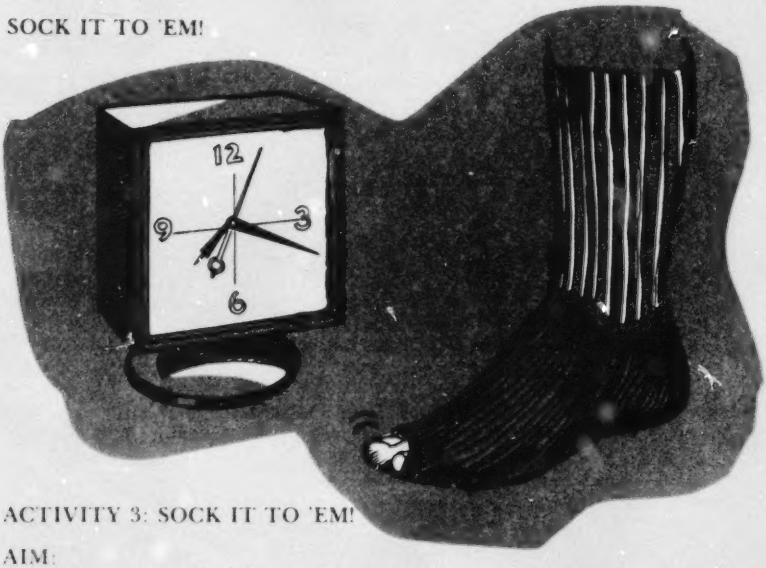
Do these temperatures in favorite rooms vary? Yes _____ No _____
What does this tell you about family members? (Remember to test yourself, too!)

ADDED IDEA

Test the center of each room with your thermometer. Add these readings on the chart with a color pen. Is the difference between each room's center and wall temperature greater than 5°F (2.6°C)? Yes _____ No _____ Which rooms have this problem?

Are there any reasons other than inadequately insulated exterior walls that might cause the difference in room temperature readings? Yes_____ No_____ What might they be?

SOCK IT TO 'EM!



ACTIVITY 3: SOCK IT TO 'EM!

AIM:

- to determine whether each person has a different skin temperature and at which point comfort is greatest
- to learn how clothing insulation works

ATTITUDE:

Clothing is the "fur and feathers" of people. However, clothing does not need to be thick, oily or heavy to keep us warm! Today there are many kinds of fabrics that we can choose for maximum skin comfort for all kinds of activities and climates.

ACTIVITY:

Collect a variety of socks - nylons, wool or acrylic, sweat socks, sport cottons, dress polyesters, etc. Gather all the thermometers of around 91.5°F (33°C), masking tape, and willing feet that you can find. First, tape the thermometer to the ankle and measure the skin temperature of each bare foot and record it below. Wait 5 minutes to get a good reading. Then measure the same foot covered with its favorite sock. Put another sock over that. Measure again. Layer a third sock and take the foot's skin temperature.

NAME	Foot (Left or Right)	SKIN TEMPERATURE			
		Bare Foot	1 Sock	2 Socks	3 Socks

Circle in red the temperature that each foot's owner says is the most comfortable. Compare the choices of several feet. What does this tell you about people's skin comfort?

- Hopefully, someone will have a holey sock. Record its temperature, too. How does it compare with a holey house?

- If someone is willing, measure skin comfort with a damp sock. How does the foot feel now? _____ Would a damp sock make any difference in summer heat outdoors? Yes_____ No_____ Why?

Hidden holes in the home may lose additional heat or cause heat to enter cooled spaces in summer. These holes include electric outlets on exterior walls. They can lose as much heat as all the windows (about 13% each of a homes' total heat loss). If you remove the screws and outlet plates carefully, you may find gaps in the walls. Cover these with your own insulation "gaskets" made of soft, thin polyurethane foam, or buy them. Outline on foam, slip it behind the plate and screw back the plate. SAFETY NOTE: If outlet wiring is old or faulty alert an adult for replacement.

Additional holes may be found in walls or ceilings that face unheated spaces, such as furnace flues, vents, attic ducts, and ceiling fixtures. These areas may require caulking.

AIMS:

- to relate home energy consumption and cost
- to prepare for computerized analysis of energy efficiency

ATTITUDE:

An audit is a recheck of previous monitoring and record keeping. In some states a centralized computer facility serves keyboard terminals in every county. In Nebraska, the audit is called "HOUSE" through the AGNET computer service. Residents of both urban and rural areas can obtain a "House User Input" form from their County Extension Service, fill it out and return the audit for a computer analysis of home energy use, annual heating/cooling costs, and economical home improvements.

Nebraska AgNet Computer terminal provides an analysis of home energy use.

Photo: Dick Dodds

ACTIVITY:

Take the following information after you fill it out, to your leader or parent for a computerized audit. Compare your home's energy loss, use and recommendations with others.

Shortcut: Find a blueprint of your house. If not found, gather the following data: heated floor area (length x width of each room, add up all rooms) _____ sq. ft. divided by 9.3 = _____ sq. m.
area of all windows and doors without storms (length x width) _____
sq. ft. divided by 9.3 = _____ sq. m.

Number of south windows _____

Perimeter of outside walls _____ ft. _____ meters

Depth of above-ceiling insulation _____ inches _____ cm.

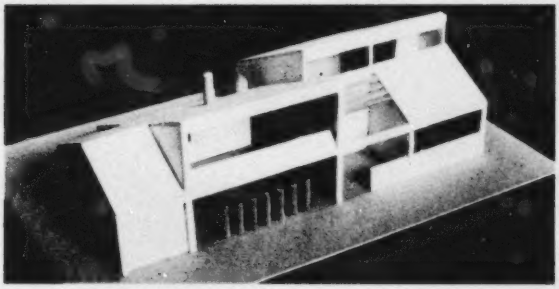
Quality of window caulking _____ poor _____ fair
_____ good
Doors, windows weatherproofed _____ poor _____ fair
_____ good

Water heater setting _____ °F _____ °C

Thermostat settings:

	Nighttime	Daytime	% Humidity
Summer			*
Winter			**

* Should be 50 percent or less with air conditioning.
**If condensation on windows, reduce furnace humidity control.



This passive-solar home of 1400 sq. ft. (127 sq. m.) stores heat in 7 water-filled tubes and special storage walls and floors. Architect: Robert Alfieri of Clark Enersen Partners, Lincoln, NE. Photo: Dick Dodds

Collector's Box

AIM:

- to make a model solar collector
- to show how the sun can help reduce home energy consumption and costs
- to learn concepts of solar energy collecting

ATTITUDE:

Solar energy for homes involves collecting, storing and distributing the sun's heat. There are many approaches and problems involved with these three solar steps. Collectors are generally large because the sun's heat per square inch (sq. cm) is generally insufficient.

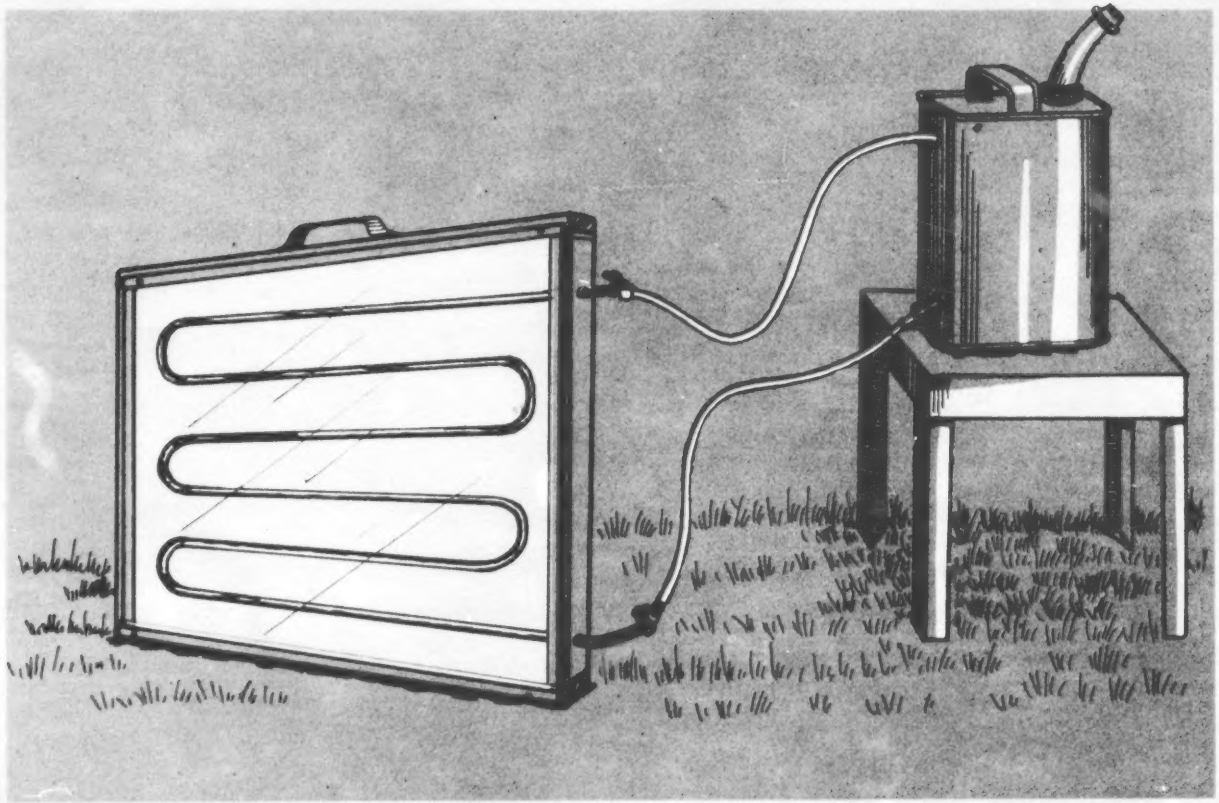
TWO BASIC TYPES OF SOLAR COLLECTORS HAVE BEEN IN USE:

1. *Flat plate collector*, which is a flat, large glass covered black box that absorbs light energy and converts it to heat. If black painted copper tubing is attached, the collector can be used to heat water. Cold water is warmed by the absorber surface and is stored in its tank.
2. *Focusing collectors* that reflect or refract the sun's light and concentrate it. Fire safety means should be taken with these collectors because of the concentrated heat. When motors such as those in water pumps are needed to move solar heated air or water in a home, keep in mind that fuels are usually the sources used to drive the equipment. Does this defeat the purpose of the solar collecting? Your opinion is _____

A useful device for hot water heating and storage is the solar collector panel and tank. Once you have made a small model you will understand the idea of solar collection, storage, and distribution. Then you can plan a large, permanent solar water heater for your future home. A family of four would need an 80-gallon storage tank heated by an 80 sq. ft. (8.6 sq.m) collector surface. The collector should be placed at a 45-60° angle to the sun and the water tank must be placed above the collector. As the water within the tubing is warmed, it rises and is displaced by cool; hence a thermosyphon activity.

TOOLS NEEDED:
cross cut saw
soldering gun
tin shears
utility cutting knife
staple gun
metal hole punch
hand drill with 3/8" bit
caulking gun
paint brush
sandpaper
hammer
nails

MATERIALS
1 cardboard or wooden box about 2' (65 cm) x 20" (50 cm) x 3" (7.5 cm) deep.
1 sheet of fiberglass large enough to fit inside the box
1 sheet transparent glass or thin plastic to cover the box
6' of black plastic tubing or garden hose about 1/2" (1 cm) in diameter
thermometer
scrap tin or aluminum to cover bottom of box
1 new gallon gas can (3 lb. coffee can)
1 can black paint & brush



DIRECTIONS FOR MAKING THE SOLAR WATER HEATER

1. Assemble solar water heater according to picture.
2. Make two holes (the diameter of the rubber tubing) along either end of the same side of the box.
3. If available, line the bottom of the box with metal or tin sheeting scraps.
4. Insert tubing in the holes and glue the tubing in a series of S bends along the bottom of the box.
5. Make one hole near bottom of large can and another hole about 2" from the top.
6. Use a funnel to fill the tubing with water. Pinch ends and insert into container holes. Fill container with water. Make sure connections are as watertight as possible. Caulk if necessary.

NOTE: **Thermosyphon action will not occur unless entire system is completely filled with water.**

7. Place glass or fiberglass sheet on top of box. Make it as air tight as possible.
8. Raise container to a higher elevation than the collector.
9. Using your water tank is fun! Fill the can with cold water through the screw cap until the water circulates throughout the tubes. Let the water overflow through the can opening until all air bubbles are removed. Screw the can cover on tightly. Angle the solar collector outside to face the sun at almost 45° angle for half an hour or until highest temperature occurs. (Lean it against a stool, chair or rocky ledge). Be sure the can is placed above and to the right of the collector panel and that the top, if glass, is secure. This insures that the cold water will drop down into the bottom panel tubing and that warmed water will rise into the top of the panel and into the water storage tank. Take your portable hot water heater to camp, to a picnic, etc. You'll always have hot water on hand!

With your thermometer, find out how hot the water got!

_____°F

_____°C

Besides a hot water heater, a solar collector box can be altered to dry fruits, and firewood, serve as a cold frame for seeds, or a solar warming oven. Think of some other imaginative uses for collectors and other designs. Libraries can provide other solar patterns. Your County Extension Service may also be able to furnish you with patterns and directions for specific devices.

CHECKLIST FOR JUDGING YOUR COLLECTOR'S BOX

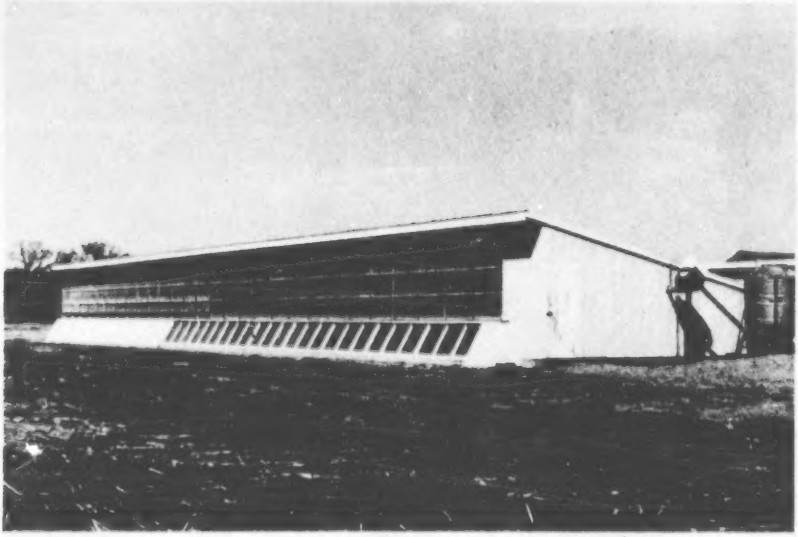
DESIGN: simple_____ interesting_____ unified apperance_____ workable design_____ parts in proportion to project needs_____ sturdy construction_____

COLLECTOR: good size for intended use, about 25 in. (65 cm) x 21 in. (53 cm) high x 2 in. (5 cm) deep_____ purpose of collector understood and practical_____ all accessories fastened_____

SAFETY: sharp edges of thin-gauge metal covered with tape or collector panel is enclosed in box_____ protective handling for screening or fiberglass_____ plastic cover if box is used instead of glass_____ all staples and nails are secure, points concealed_____

WORKMANSHIP: neat, presentable_____ carefully sanded, painted_____ innovative improved, imaginative_____

SOLAR SWINE UNIT



The concrete block floor of this well-insulated Nebraska modified open front swine building stores additional solar heat from the window collectors. The white portion at the west end covers the collector to reduce summer heat gain.

KITCHEN CONSERVATION

AIM:

- What can you do about the rising costs of food?

ATTITUDES:

We live in a country with the most productive agricultural system in the world. One American farmer feeds about 60 people. (One Russian farmer feeds 10; 20 are fed by one British farmer.) In the 1970's American agriculture contributed half the world's food exports.

Americans used to have the most plentiful and cheapest food to buy. Now food everywhere in the world is becoming more expensive due to increasing fuel costs involved in the production of fertilizers, insecticides, farm equipment, processing, packaging and transportation. More energy is used to cook food on a range (stove) than to raise it on a farm.

ACTIVITY:

Discuss some favorite food items with your family. What energy is involved in getting the food from field to table? List them here:

1.

2.

3.

4.

5.

How can your family prepare food with less energy? Ideas:

- eat fresh rather than frozen or canned foods, to eliminate processing, packaging and cooking that require fossil fuels
- freeze rather than can food
- buy food in bulk to help reduce nonrecyclable containers
- buy local produce rather than food that has traveled for long distances

With your lifestyle, would it be economical to have your own garden? List here what is involved:

Your Favorite Fruits & Vegetables	How Fertilized	How Watered	Your Garden Schedule

Ask family members to help you plan a low energy meal. List menu items:

Pick your favorite item from the menu. How is this item packaged?

Read the label to find out from what state and town your food originated. About how many miles or kilometers did it take the item to get to your table?

How would you change this item to become more energy slimming? (for example: what kitchen preparation involves energy? Could packaging be changed?)

IDEA:

A can of soda pop gives you about 130 calories of food energy. It takes 3,419 calories to produce the aluminum can. If 1 calorie equals 4 BTU's of energy, then _____ BTU's are needed for each can. What can you do to get a more energy efficient drink?

TRANSPORTATION - ALL SYSTEMS GO!

AIMS:

- to monitor gasoline usage
- to choose with your family the best fuel economy measures for your transportation needs

ATTITUDE:

Everyone says we "auto" reduce gasoline consumption and our dependence upon important petroleum. If every trip of two miles (3 km) or less were made by bicycle or on foot rather than by auto, Americans would save 2 1/2 billion gallons (9.5 billion liters) of gasoline otherwise needed because engines don't warm up and run efficiently on short runs.

ACTIVITY:

Discuss with your family the choices you plan to make to reduce auto fuel consumption and costs:

Keep tires inflated at the pressure stated in your auto manual. _____p.s.i. (lbs. pressure per sq. in.) x 7 = _____kilo-pascals

Use low friction synthetic oil. Check your manual for proper oil weight._____wt.

Keep the car tuned up, in peak operating condition. How often?_____

Reduce unnecessary vehicle weight by removing unneeded heavy tools and equipment.

Obey speed limits. What are they around school? _____ mph Home? _____ Highway? _____

Accelerate smoothly but at moderate rate to cruising speed, or lose two miles per gallon (.8 kpl) with jerky starts.

Maintain constant speed. Why?

Use the phone more often!

Use bikes, buses, and legs as often as possible.

Share rides and carpool.

Buy lightweight, energy efficient autos.

Plan on taking a drivers education course that includes saving energy.

Other ideas:

_____

_____

_____

_____

_____

_____

_____

GASOLINE USE ACTIVITY

How efficiently does your family use gasoline? You can find out by averaging the number of miles traveled per gallon (3.8 l) of gas. Record mileage for a *minimum* of 4 tank fill-ups. The gas tank should be filled each time.

TANK FILL-UP	DATE	GALLONS/ LITERS	ODOMETER READING	MILES/KM TRAVELED
No. 1				- = 0
No. 2				- =
No. 3				- =
No. 4				- =
No. 5				- =
	TOTAL	_____	÷ _____	+ _____

Total miles traveled divided by Total gallons = MPG

When you're finished, calculate in kilometers* per liter (slightly larger than a quart) from your mpg average.

_____ mpg x 1.6 # 3.8 = _____ kpl (kilometers per liter)

*A kilometer is 1000 meters or 3/5ths of a mile.

TRAVEL LOG ACTIVITY

1. Keep a log of your family's transportation needs for a week. Record in a notebook each person's needs as follows:

(Name) _____

DATE	DESTINATION (school, work, store, etc.)	MILES/KM	MEANS OF TRANSPORATION** (car, bus, legs, roller skates, bike, moped, etc.)

**Make a column for each means used.

2. When the week is over study the trips and mileage: Then discuss with your family how errands can be combined, carpools arranged, motor bikes or other means used besides the auto. Write their ideas here.

3. Make a plan for each person and record activities for another week. At the end of the second week figure out how many miles (kilometers) were saved in driving.

Miles/km saved divided by 7 days = Average miles/km saved per day x 365. = Average miles/km per year.

Using your miles per gallon (kpl) average, how many gallons (l) could you save in a year?_____gallons (l)

Check the current price per gallon (l) of gasoline. $_____

How much money would your family save in a year by using your plan? $_____

At the next club meeting be prepared to compare the choices your family has made with other members' families. How are your transportation lifestyles similar?

How do they differ?

AFTERWARDS:

Once your family has established a lowered auto budget, reduced fuel consumption effort, share your energy-conscious ideas with others. Talk to a class about effective ways that they might reduce gasoline consumption.

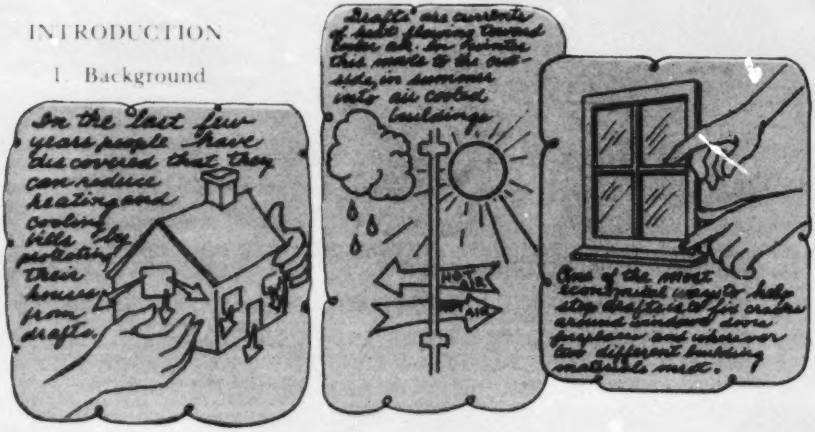
DEMONSTRATIONS GALORE!

Many 4-H'ers develop communications skills by giving demonstrations at club meetings and in the community.

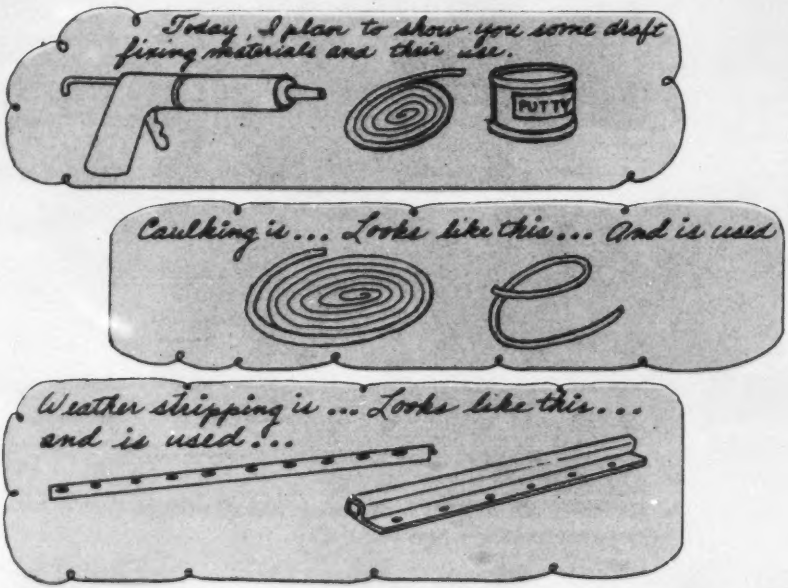
You can organize a demonstration as follows:

INTRODUCTION

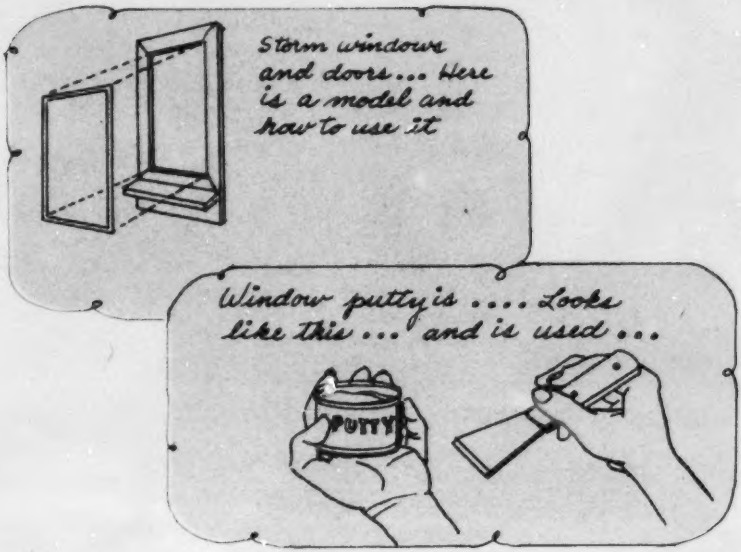
1. Background


In the last few years people have discovered that they can reduce heating and cooling bills by protecting their houses from drafts.
Drafts are currents of cold flowing toward heat. In winter this cold is the outside, in summer into air cooled buildings.
HOT
COLD
One of the most economical ways to help stop drafts is to fix cracks around windows, doors, fireplaces and wherever two different building materials meet.

2. Tell your plan


Today, I plan to show you some draft fixing materials and their use.
PUTTY
Caulking is ... Looks like this ... And is used
Weather stripping is ... Looks like this ... and is used ...

BODY OF DEMONSTRATION



CONCLUSION

Even though this is a very small part of protecting your house against drafts, it is a first step in home energy conservation. Once you have used these materials and methods you may realize savings in your home heating and cooling bills of over $60 a year.

HERE ARE SOME TALK TOPICS FOR DEMONSTRATIONS. ADD YOUR OWN INTEREST TO THE LIST BELOW. WHAT VISUAL AIDS ENHANCE YOUR DEMONSTRATIONS (IN ADDITION TO POSTERS AND WORKING MODELS?)

HOW TO DETECT INVISIBLE DRAFTS AND FIX THEM
WHAT MAKES INSULATION WORK?
FORMS OF ENERGY IN THE FOOD CYCLE
MEET YOUR ELECTRIC METER
RENEWABLE ENERGY RESOURCES
HOW TO FIX A LEAKY HOT WATER FAUCET
YOUR IDEAS HERE

Ask for a 4-H manual on giving demonstrations from your County Extension Office.

ENERGY ALTERNATIVES

AIM:

- to understand energy alternatives for now and the future

ATTITUDE:

All energy can be traced back to the sun. Wind and tides are dependent upon the Earth's revolution and rotation around the sun. Trees and other plants are the Earth's most efficient energy users. Each year trees form new "solar collectors."

An energy alternative is one that is carefully chosen or selected to work, heat, or light for us. Another alternative to finding energy resources is energy *conservation*, which has been included in this book.

ACTIVITIES:

- Make a sun mobile with poster board, color markers, string and tape. Attach to the sun rays some cut outs of the energy alternatives you can recall, such as coal, food, ocean tides. Show your mobile to others and tell how each alternative relates to solar energy.
- On poster board make a chart of some energy conservation choices (alternatives) that families can make.

example:

ALTERNATIVE:	RATHER THAN BIG ENERGY USER:
wear a sweater in winter	turn up thermostat
eat apple snack	snack on processed food
recycle	litter

Give a demonstration, or make a trail game from what you learned.

- Demonstrate why trees and other green plants are the sun's most efficient energy users. Green collectors have to be living for best absorption of sun's rays. Plants store energy in many forms such as cellulose, starch and sugar. Trees and other plants give us shade, wind protection, fruit, beauty, construction materials. The wood is used for heat but is economical only if people grow and cut their own. If only trees could grow fast enough to be replaced, didn't cause burning pollution, and were used in the most efficient stoves and fireplaces.

- This book is printed on recycled paper from trees (for fun, trace back to the sun). Recycle your own paper by making it! Shred 10-15 newspaper strips into a bowl half filled with water. Use an egg beater or blend until the mixture is pulpy. Pour pulp over a framed mesh screen set over a tray. Wait one minute until the water drains. Cover screen top and bottom with two layers of newspaper, pat to absorb moisture, remove sheets of newspaper. Set pulp on

screen in sun to dry. Write paper making directions on your new paper and show at next meeting.

- List on recycled paper some other recycling ideas. For example, take coathangers to dry cleaners for reuse. Start with tin recycling center in your community (since tin has to be imported). Reuse grocery bags. Recycle outgrown denims through a community collection, sale, exchange, or cut them into strips, sew into longer strips and crochet or weave into a rag rug.
- Create your own talk on the question: "What are some ways people collect, absorb, store and distribute the sun's rays?"

ENERGY PLAY

AIM:

- to share your energy knowledge entertainingly with others

ACTIVITIES:

- Lights! Scripts! Action! Play writing can be organized as follows: 1) What is the problem? 2) What interferes with solving the problem? (villains, comedians)? 3) What is the climax or turning point? 4) How is the problem settled (ending)? Some play problems could be:
- There are no more fossil fuels in the world. Show actors reverting to people-and-animal power for existing machines. How can you act out human "group heaters and coolers" for such daily tasks as cooking, hair drying, and transportation to school and sports events?
- Do a futuristic play with people living in space due to overpopulation, pollution, earthly boredom, etc. Do library research on solar space power, lunar materials for industry, convincing future energies.
- Someone goes around "sticking up" everything in town that appears to be an energy hazard! People are embarrassed when they mysteriously get "energy waster" stickers on their backs. The culprit gets caught but in court the energy gluttons reveal their wastefulness. The jury decides that the energy stick-up has some great ideas.
- You have awakened — or it is a dream — to find all your appliances are alive and complaining about how they are poorly maintained and wastefully used. Cardboard boxes from appliance stores can hold live actors, or put your play into puppetry with simple cardboard appliances on popsicle sticks and a shirt box for the stage.
- Teens need hot and cold weather clothes on a shoestring budget. Offer solutions with energy-saving colors, fabrics, textures and how they affect body insulation and comfort. Show energy saving ideas for clothing maintenance, plus t-shirts with energy slogans.

Present your play to your school, church, community. Film it or borrow a video tape recorder from school or your county agent. Try writing, planning

and taping a radio show about

- 5-to 30-second commercials on saving home energy
- the continuing episodes of Surelook Homes, the great House Energy Detective (Use sound effects near the microphone: crumple cellophane for fire, drill a hole in wood and twist a wooden pencil in it for a creaking, drafty door; drop dried peas on a metal sheet for rain; scratch a nail over glass for screeching brakes; hold the mike near an electric motor for a car engine; tap a large piece of tin for thunder; walk your fingers over a book for footsteps.)

OTHER ENERGY IDEAS TO PLAY WITH

- Design and distribute some energy super graphics made from paper, sewn fabric, wood, etc. They can be 2 or 3-Dimensional!
- Plan an energy free party or picnic. Walk or bike to it as a group!

RESOURCES

PEOPLE

NEBRASKA ENERGY OFFICE
State Capitol
P.O. Box 95085
Lincoln, NE 68508

U.S. DEPARTMENT OF ENERGY (DOE)
Technical Information Center
P.O. Box 62
Oak Ridge, TN 37830

American Assn. for the
Advancement of Science
1515 Massachusetts Ave., NW
Washington, D.C. 20005

STATE 4-H DEPARTMENT
COOPERATIVE EXTENSION SERVICE
Ag. Hall, 116
University of Nebraska
Lincoln, NE 68583

Dean's Office
Energy Research and
Development Center
College of Engineering and
Technology
University of Nebraska
Lincoln, NE 68583

Nebraska State Solar
Energy Office
W191 Nebraska Hall
University of Nebraska
Lincoln, NE 68508

PUBLICATIONS:

Morrison, James. NEBRASKA ENERGY SAVING MANUAL. New York: Harper & Row, Publishers. Nebraska Energy Office, Box 95085, Lincoln, 68509.

Voegeli, Henry E., & Tarrant, John. SURVIVAL 2001: SCENARIO FOR THE FUTURE. New York: Van Nostrand Reinhold Co., 1975.

Prenis, John, Editor. ENERGYBOOK #1: NATURAL SOURCES AND BACKYARD APPLICATIONS. 3rd Printing, 1976, from Running Press, 38 So. 19th St., Philadelphia, PA, 19103.

Wells, Malcolm. ENERGY ESSAYS. Edmund Scientific Co., Publishers, 1976, 70 pp.

"Energy Conservation: Experiments You Can Do." Thomas Edison Foundation, 1974, 32 pp.

Wilson, Janet. Home Economics NEB Guides: "Easy on Energy—With Appliance" (HEG 78-95) and "Easy on Energy—At Home" (HEG 78-96) from Cooperative Extension Service, Institute of Agriculture and Natural Resources (IANR), University of Nebraska, Lincoln, 68583.

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